

WHAT IS CLAIMED IS:

1. An apparatus for monitoring the dynamic loading rate on support systems used in an underground mine to withstand abutment pressure, comprising:

- 5 at least one load sensing device adapted to be coupled to one or more of the support systems used in the underground mine;
- a programmable controller for processing support system loading information received from said at least one load sensing device; and
- 10 a plurality of sensory indicators controlled by said programmable controller to provide timely warning indications used as an aid in determining when to install additional support systems and alert miners of dangerous loading conditions on the support systems during mining operations on a real-time basis.

2. An apparatus as recited in claim 1 wherein said load sensing device comprises a pressure transducer.

3. An apparatus as recited in claim 1 wherein said load sensing device comprises a strain gauge.

4. An apparatus as recited in claim 1 wherein said load sensing device is adapted to be coupled to one or more of longwall shields, mobile roof support (MRS) machines, hydraulic jacks, rock bolts, steel sets, roof trusses and the like.

5. An apparatus as recited in claim 4 wherein said load sensing device is mounted with the underground mine support systems.

6. An apparatus as recited in claim 1 wherein said programmable controller comprises an embedded microprocessor having based system.

7. An apparatus as recited in claim 1 wherein said programmable controller monitors loading rate changes on said load sensing device installed on the support systems.

8. An apparatus as recited in claim 7 wherein said programmable controller calculates the loading rates on said load sensing device.

9. An apparatus as recited in claim 7 wherein said plurality of sensory indicators comprise various color visual indicators including multicolor strobes, light-emitting diodes (LEDs), fluorescent visual indicators and the like.

10. An apparatus as recited in claim 9 wherein said programmable controller is programmed to sequentially activate different color lights as the loading rate increases on the support systems.

11. An apparatus as recited in claim 7 wherein said plurality of sensory indicators comprise audible alarm indicators.

12. An apparatus for monitoring the dynamic loading rate on support systems used in an underground mine to withstand abutment pressure, comprising:

5 means for installing at least one load sensing device on one or more of the support systems used in the underground mines;

means for receiving support system loading information from said at least one load sensing device;

means for determining the loading rate on the support systems using the received loading information; and

10 means for activating sensory warning indicators responsive to said determining means to provide timely warning indications used as an aid in determining when to install additional support systems and alert miners of

51
22
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dangerous loading conditions on the support systems during mining operations on a real-time basis.

13. An apparatus as recited in claim 12 wherein said determining means identifies changes in the loading rate on the support systems.

14. An apparatus as recited in claim 13 comprising means for sequentially activating different color lights and audio alarms as the loading rate increases on the support systems.

15. A method of monitoring the dynamic loading rate on support systems used in an underground mine to withstand abutment pressure, comprising:

installing at least one load sensing device on one or more of the support systems used in the underground mines;

receiving support system loading information from the at least one load sensing device;

determining the load rate on the support systems using the received loading information; and

activating sensory warning indicators to provide timely warning indications used as an aid in determining when to install additional support systems and alert miners of dangerous loading conditions on the support systems during mining operations on a real-time basis.

16. A method as recited in claim 15 comprising the step of identifying changes in the loading rate on the support systems.

17. A method as recited in claim 16 wherein said activating step provides warning indications in response to said identifying step.

18. A method as recited in claim 17 comprising the step of sequentially activating different color lights as the loading rate increases on the support systems.

19. The method as recited in claim 15 wherein the load sensing device is hydraulically coupled to the support systems in the installing step.

20. A method as recited in claim 15 wherein the load sensing device is welded onto the support systems in the installing step.

21. An apparatus for monitoring the dynamic loading rate on support systems to withstand abutment pressure, comprising:

at least one load sensing device adapted to be coupled to one or more of the support systems;

a programmable controller for processing support system loading information received from said at least one load sensing device; and

a plurality of sensory indicators controlled by said programmable controller to provide timely warning indications used as an aid in determining when to install additional support systems and alert workers of dangerous loading conditions on the support systems on a real-time basis.